



## Particle Physics Division

### Mechanical Department Engineering Note

Number: MD-ENG-258

Date: June 25, 2010

Project: NOvA Near Detector

Project Internal Reference:

Title: NOvA Near Detector Platform

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Key Words: NOvA, Platform, Steel Floor Grating

Abstract/Summary:

The existing NOvA Near Detector work platform consists of two working levels and is fabricated from standard structural steel shapes. Both floors are constructed from standard steel floor grating. The lower floor grating bearing bars are 1 inch by 3/16 inch spaced at 1-3/16 inch centers. Cross bars are spaced at 4 inches on center.

The existing design of the lower floor has the floor grating ending at the face of the spandrel support channel which is approximately 12 inches back from the side of the detector. It was determined that it would be desirable to extend the floor grating 12 inches past the support channel to facilitate servicing the detector.

This calculation checks the existing floor grating for the negative moment and additional end reaction produced by cantilevering the floor grating 12 inches from the original support.

Applicable Codes:

*AMICO Gratings and Expanded Metals Catalog, 01/07-13M, Alabama Metal Industries Corporation, Birmingham, Alabama, 35208.*

*Manual of Steel Construction, Allowable Stress Design, Ninth Edition, American Institute of Steel Construction, 1989.*

NOVA  
NEAR DETECTOR

PLATFORM

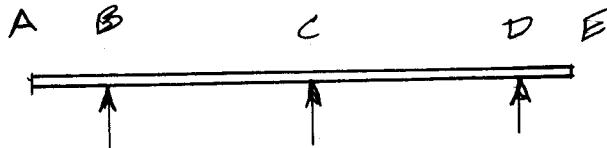
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FLEXURAL LOAD:

$$\begin{aligned}\text{DEAD LOAD (GRATING)} &= 10 \text{#/FT}^2 \\ \text{LIVE LOAD} &= 50 \text{#/FT}^2\end{aligned}$$

$$\overline{60 \text{#/FT}^2} = 0.42 \text{#/IN}^2$$

GRATING:



STIFFNESS:

$$K_{BA} = 0 \text{ SINCE DF FOR A CANTILEVER} = 0$$

$$K_{BC} = \frac{3}{4} \left( \frac{1}{34.5} \right) = 0.022$$

$$K_{DC} = \frac{3}{4} \left( \frac{1}{34.5} \right) = 0.022$$

DISTRIBUTION FACTORS (DF)

JOINT B

$$\Sigma K = 0 + 0.022 = 0.022$$

$$DF_{BA} = \frac{0}{0.022} = 0$$

$$DF_{BC} = \frac{0.022}{0.022} = 1.0$$

JOINT C

$$\Sigma K = 0.022 + 0.022 = 0.044$$

$$DF_{CB} = \frac{0.022}{0.044} = 0.5$$

$$DF_{CD} = \frac{0.022}{0.044} = 0.5$$

JOINT D

$$\Sigma K = 0 + 0.022 = 0.022$$

$$DF_{DC} = \frac{0.022}{0.022} = 1.0$$

$$DF_{DE} = \frac{0}{0.022} = 0$$

	A	B	C	$0.42 \text{#/in}$	D	E
	12"	34.5"	34.5"	9"		
MEMBER	AB	BA	BC	CB	CD	DC
D.F.	0	0	1.0	-0.5	0.5	1.0
FEM	0	-30.2	+41.7	-41.7	+41.7	-41.7
D.H.T	0	-11.5	0	0	0	+24.0
TOTAL	0	-30.2	+30.2	-41.7	+41.7	-170
SIMPL. SPAN REACTION	↑5.04	↑7.25		↑7.25	↑7.25	↑3.78
MOMENT REACTION	0	↑1.33		↓.33	↑.72	↓.72
TOTAL	↑5.04	↑7.58		↑6.92	↑7.97	↑6.53
TOTAL JOINT REACTION		↑12.62 #		↑14.89 #		↑10.31 #

CHECK  $1\frac{1}{4} \times \frac{3}{16}$  STEEL GRATING FOR ALLOWABLE LOADS:  
 FROM "AMICO INDUSTRIAL CATALOG" (SEE P.4 THIS C.R.)  
 FOR WELDED STEEL GRATING W/  $1\frac{1}{4} \times \frac{3}{16}$ " C  $1\frac{1}{16}$ " CC.  
 MAX. ALLOWABLE LOAD =  $420 \text{#/ft}^2$  < 36" SPAN

$$\text{MAXIMUM REACTION} = 420(34/(12))/2 \\ = 632 \text{#/FT}$$

$$\text{REACTION FROM ABOVE LOADING} = 14.89(12/\text{ft}) \\ = 179 \text{#/FT}$$

$179 \text{#/FT} < 632 \text{#/FT}$  OK

NOVA

NEAR DETECTOR

PLATFORM

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JUNE 25, 2010

3

$$\text{MAXIMUM MOMENT} = \frac{439(36/12)^2}{8}$$
$$= 494 \text{ #-FT/FT}$$

MAXIMUM MOMENT FROM ABOVE LOADING:

$$41.7 \text{ #-IN} \left( \frac{1\text{FT}}{12\text{IN}} \right) = 3.5 \text{ # FT/IN}$$

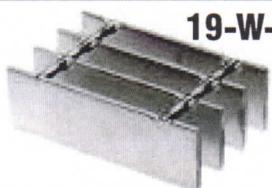
$$3.5 \text{ # FT/IN} \times \frac{12\text{IN}}{\text{FT}} = 41.7 \text{ # FT/FT}$$

$$41.7 \text{ # FT/FT} < 494 \text{ # FT/FT} \quad \underline{\text{OK}}$$

USE 1" X 3/16" BEARING BARS SPACED @ 1 3/16 C.C.

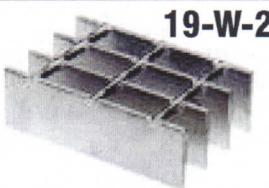
# Steel Bar Grating

## WELDED (W) 1-3/16" C/C Bearing Bars



Cross Rods 4" C/C

**19-W-4**



Cross Rods 2" C/C

NON-SERRATED & SERRATED

## PRESS-LOCKED (P) 1-3/16" C/C Bearing Bars



Cross Bars 4" C/C

**19-P-4**



Cross Bars 2" C/C

NON-SERRATED & SERRATED

## LOAD & DEFLECTION TABLE

**General:** Loads and deflections are theoretical and based on static loading.

Bar Size	Symbol	Approx. Weight psf	Sec. Mod. Per Ft. Of Width	SPAN (Direction of Bearing Bar)								60"	66"
				24"	30"	36"	42"	48"	54"	60"	66"		
<b>3/4" x 1/8"</b>	19-W-4	3.9	0.118	U 355	227	158	116	89	70	101	84	0.466	0.563
	19-P-4	4.3		D 0.099	0.155	0.223	0.304	0.397	0.503				
	19-P-2	5.2		C 355	284	237	203	178	158				
	19-W-4	5.6		D 0.079	0.124	0.179	0.243	0.318	0.402				
<b>3/4" x 3/16"</b>	19-P-4	6.4	0.178	U 533	341	237	174	133	105	0.377	0.377	0.377	0.377
	19-P-2	7.8		D 0.099	0.155	0.223	0.304	0.397	0.503				
	19-W-4	5.0		C 533	426	355	305	266	237				
	19-W-2	5.5		U 632	404	281	206	158	125				
<b>1" x 1/8"</b>	19-P-4	5.4	0.211	D 0.074	0.116	0.168	0.228	0.298	0.377	0.466	0.563	0.466	0.563
	19-P-2	6.3		C 632	505	421	361	316	281				
	19-W-4	7.2		U 947	606	421	309	237	187				
	19-W-2	7.8		D 0.074	0.116	0.168	0.228	0.298	0.377				
<b>1" x 3/16"</b>	19-P-4	8.1	0.316	C 947	758	632	541	474	421	0.379	0.344	0.379	0.344
	19-P-2	9.5		D 0.060	0.093	0.134	0.182	0.238	0.302				
	19-W-4	6.1		U 987	632	439	322	247	195	0.451	0.536	0.451	0.536
	19-W-2	6.6		D 0.060	0.093	0.134	0.182	0.238	0.302				
<b>1-1/4" x 1/8"</b>	19-P-4	6.8	0.329	C 987	789	658	564	493	439	0.395	0.329	0.395	0.329
	19-P-2	8.1		D 0.048	0.074	0.107	0.146	0.191	0.241				
	19-W-4	8.9		U 1480	947	658	483	370	292				
	19-W-2	9.5		D 0.060	0.093	0.134	0.182	0.238	0.302				
<b>1-1/4" x 3/16"</b>	19-P-4	10.2	0.493	C 1480	1184	987	846	740	658	0.592	0.538	0.592	0.538
	19-P-2	12.1		D 0.048	0.074	0.107	0.146	0.191	0.241				
	19-W-4	7.2		U 1421	909	632	464	355	281	0.248	0.300	0.248	0.300
	19-W-2	7.7		D 0.050	0.078	0.112	0.152	0.199	0.251				
<b>1-1/2" x 1/8"</b>	19-P-4	7.9	0.474	C 1421	1137	947	812	711	632	0.568	0.474	0.568	0.474
	19-P-2	9.2		D 0.040	0.062	0.089	0.122	0.159	0.201				
	19-W-4	10.5		U 2132	1364	947	696	533	421	0.341	0.282	0.341	0.282
	19-W-2	11.2		D 0.050	0.078	0.112	0.152	0.199	0.251				
<b>1-1/2" x 3/16"</b>	19-P-4	11.8	0.711	C 2132	1705	1421	1218	1066	947	0.853	0.775	0.853	0.775
	19-P-2	13.8		D 0.040	0.062	0.089	0.122	0.159	0.201				
	19-W-4	12.2		U 2901	1857	1289	947	725	573	0.464	0.384	0.464	0.384
	19-W-2	12.8		D 0.043	0.067	0.096	0.130	0.170	0.215				
<b>1-3/4" x 3/16"</b>	19-P-4	13.5	0.967	C 2901	2321	1934	1658	1451	1289	1.161	1.055	1.161	1.055
	19-P-2	15.4		D 0.034	0.053	0.077	0.104	0.136	0.172				
	19-W-4	13.9		U 3789	2425	1684	1237	947	749	0.606	0.501	0.606	0.501
	19-W-2	14.5		D 0.037	0.058	0.084	0.114	0.149	0.189				
<b>2" x 3/16"</b>	19-P-4	15.2	1.263	C 3789	3032	2526	2165	1895	1684	1.516	1.378	1.516	1.378
	19-P-2	17.1		D 0.030	0.047	0.067	0.091	0.119	0.151				
	19-W-4	15.5		U 4796	3069	2132	1566	1199	947	0.767	0.634	0.767	0.634
	19-W-2	16.1		D 0.033	0.052	0.074	0.101	0.132	0.168				
<b>2-1/4" x 3/16"</b>	19-P-4	16.8	1.599	C 4796	3837	3197	2741	2398	2132	0.807	0.744	0.807	0.744
	19-P-2	18.7		D 0.026	0.041	0.060	0.081	0.106	0.134				
	19-W-4	17.2		U 5921	3789	2632	1933	1480	1170				
	19-W-2	17.8		D 0.030	0.047	0.067	0.091	0.119	0.151				
<b>2-1/2" x 3/16"</b>	19-P-4	18.5	1.974	C 5921	4737	3947	3383	2961	2632	0.838	0.736	0.838	0.736
	19-P-2	20.4		D 0.024	0.037	0.054	0.073	0.095	0.121				

### W/P-19 PANEL WIDTH (inches)

Note: P-Press-Locked cross bars typically extend 1/8" each side. W-Welded cross rods may extend 1/8" each side. Panel widths do not include these extensions.

No. of Bars	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1/8" Bar	1 <sup>5</sup> / <sub>16</sub>	2 <sup>1</sup> / <sub>2</sub>	3 <sup>11</sup> / <sub>16</sub>	4 <sup>7</sup> / <sub>8</sub>	6 <sup>1</sup> / <sub>16</sub>	7 <sup>1</sup> / <sub>4</sub>	8 <sup>7</sup> / <sub>16</sub>	9 <sup>5</sup> / <sub>8</sub>	10 <sup>13</sup> / <sub>16</sub>	12	13 <sup>3</sup> / <sub>16</sub>	14 <sup>3</sup> / <sub>8</sub>	15 <sup>5</sup> / <sub>16</sub>	16 <sup>3</sup> / <sub>4</sub>	17 <sup>15</sup> / <sub>16</sub>
3/16" Bar	1 <sup>3</sup> / <sub>8</sub>	2 <sup>9</sup> / <sub>16</sub>	3 <sup>3</sup> / <sub>4</sub>	4 <sup>15</sup> / <sub>16</sub>	6 <sup>1</sup> / <sub>8</sub>	7 <sup>5</sup> / <sub>16</sub>	8 <sup>1</sup> / <sub>2</sub>	9 <sup>11</sup> / <sub>16</sub>	10 <sup>7</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>16</sub>	13 <sup>1</sup> / <sub>4</sub>	14 <sup>7</sup> / <sub>16</sub>	15 <sup>5</sup> / <sub>8</sub>	16 <sup>13</sup> / <sub>16</sub>	18
No. of Bars	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1/8" Bar	19 <sup>1</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>16</sub>	21 <sup>1</sup> / <sub>2</sub>	22 <sup>11</sup> / <sub>16</sub>	23 <sup>7</sup> / <sub>8</sub>	25 <sup>1</sup> / <sub>16</sub>	26 <sup>1</sup> / <sub>4</sub>	27 <sup>7</sup> / <sub>16</sub>	28 <sup>5</sup> / <sub>8</sub>	29 <sup>13</sup> / <sub>16</sub>	31	32 <sup>3</sup> / <sub>16</sub>	33 <sup>3</sup> / <sub>8</sub>	34 <sup>9</sup> / <sub>16</sub>	35 <sup>3</sup> / <sub>4</sub>
3/16" Bar	19 <sup>3</sup> / <sub>16</sub>	20 <sup>3</sup> / <sub>8</sub>	21 <sup>9</sup> / <sub>16</sub>	22 <sup>3</sup> / <sub>4</sub>	23 <sup>15</sup> / <sub>16</sub>	25 <sup>1</sup> / <sub>8</sub>	26 <sup>5</sup> / <sub>16</sub>	27 <sup>1</sup> / <sub>2</sub>	28 <sup>11</sup> / <sub>16</sub>	29 <sup>7</sup> / <sub>8</sub>	31 <sup>1</sup> / <sub>16</sub>	32 <sup>1</sup> / <sub>4</sub>	33 <sup>7</sup> / <sub>16</sub>	34 <sup>5</sup> / <sub>8</sub>	35 <sup>13</sup> / <sub>16</sub>

U = safe uniform load, psf (page 93)  
C = safe concentrated load, psf (page 93)  
D = deflection, inches  
E = modulus of elasticity, 29,000,000 psi  
F = fiber stress, 18,000 psi

**Material:** ASTM A-1011 standard  
**Deflection:** Spans and loads to the right of the bold line exceed 1/4" deflection for uniform load of 100 psf which provides safe pedestrian comfort. These can be exceeded for other types of loads with engineer's approval.